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The Effect of Anemia with Iron Tanks on the Fetal Female Body

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Abstract: Many health features of a pregnant woman have an impact on the condition of the fetus and subsequently the newborn. Iron deficiency anemia is the most frequently detected pathology during pregnancy, which not only worsens a woman's quality of life, but can also negatively affect the condition of the fetus. Due to iron deficiency, adverse pregnancy outcomes have been described in the literature, a number of which have been reliably confirmed. Timely detection and effective therapy of iron deficiency anemia in pregnant women can prevent the development of complications and thereby improve pregnancy outcomes.

Iron deficiency is the most common cause of anemia in pregnant women. According to 2011 data, it has been proven that more than 50% of all cases of anemia during pregnancy are associated with iron deficiency. In this regard, the issues of the possible effect of iron deficiency anemia (IDA) on the fetus and on pregnancy outcomes in general are extremely relevant. It is known that an increase in blood volume during pregnancy and fetal growth create an additional need for iron for a pregnant woman (the average daily iron requirement increases from 0.8 mg/day in the first ten weeks to 7.5 mg/ day in the last ten weeks.

The proportion of the fetus in iron intake is 75 mg of iron per kg. The total iron requirement during pregnancy is more than 1000 mg on average. In the case of insufficient intake or assimilation of iron by the maternal body, iron deficiency develops, and then in the absence of correction – IDA. The effect of maternal iron deficiency on fetal health has been repeatedly discussed in the literature. It has been shown that severe anemia with a decrease in hemoglobin of less than 90 g/l can contribute to pregnancy complications and adversely affect its outcomes. The results of observational studies show a clear link between prenatal anemia and the risk of premature birth, but the evidence for other outcomes is contradictory. Clinical trials of iron supplementation during pregnancy have shown a significant improvement in hemoglobin concentration and a reduction in the risk of fetal complications such as reduced birth weight.

Delivery of iron to the fetus

Normally, the functioning of the placenta directly reflects the interaction between the maternal and fetal bloodstreams, providing nutrition, oxygen, fluid and electrolytes and removing fetal waste and carbon dioxide. Disturbances in the physiological processes occurring in the placenta can negatively affect the fetus. The fetus is very efficient at consuming iron from the mother's body, even when iron stores are depleted. The transfer of iron from mother to fetus is compensated by a significant increase in iron absorption in the mother during pregnancy. The main placental transfer of iron to the fetus occurs after 30 weeks of pregnancy, therefore, with

initially reduced iron stores in the mother, the risk of worsening anemia increases as pregnancy progresses. When maternal iron stores are reduced, the number of placental transferrin receptors increases, so more iron is taken up by the placenta. The power of this system may not be enough to provide the fetus with iron in cases where the mother suffers from iron deficiency.

Anemia and the condition of a pregnant woman

Previous data from retrospective observations have demonstrated an association between severe anemia and an increased risk of maternal mortality. Obviously, such data do not prove that anemia is the cause of death, since both anemia and subsequent mortality could be caused by some other condition. There are currently no prospective controlled studies demonstrating that anemia per se increases the risk of maternal mortality. For example, in a large Indonesian study, the incidence of maternal mortality with hemoglobin <100 g/L was 70.0 per 10,000 births compared with 19.7 per 10,000 births for women without anemia. However, the authors suggest that the association of maternal mortality with anemia reflects more the effects of hemorrhage and late hospitalization rather than the influence of prenatal anemic conditions. The table shows the main manifestations of IDA in pregnant women, as well as the key problems caused by it in the fetus/newborn. Clinical manifestations of IDA during pregnancy are nonspecific; the most common symptoms are fatigue, irritability, decreased concentration, hair loss, and poor exercise tolerance. There is evidence of the adverse effect of IDA on the formation of the placenta and an increased risk of placental abruption and hemorrhage during childbirth.

In this regard, timely diagnosis and adequate therapy of IDA have a positive effect on pregnancy outcomes for both the mother and the fetus.

Mechanisms of the influence of anemia on the fetus

Allen et al. suggested the presence of 3 potential mechanisms through which maternal IDA may affect the fetus: hypoxia, oxidative stress and infections. Chronic hypoxia due to anemia can initiate a stress response with subsequent release of corticotropin-releasing hormone (CRH) by the placenta, increased fetal cortisol production, and early labor.

Factors predisposing to premature onset of labor and intrauterine growth restriction are similar. Anemia (causing hypoxia) and iron deficiency (by increasing serum norepinephrine concentrations) can cause maternal and fetal stress, which stimulates CRH synthesis. Elevated concentrations are a major risk factor for preterm birth and preeclampsia. CRH also increases cortisol production, which can interfere with fetal growth. The production of glucocorticoids is also enhanced as a central adaptive mechanism, which in turn promotes the catabolism of fat, glycogen and protein, which over time can lead to impaired muscle growth and wasting. Iron deficiency may also increase the risk of maternal infection, which increases due to a decreased immune response. For example, with iron deficiency, the proliferation of T- and B-lymphocytes changes, the activity of phagocytes and natural killer cells decreases. Infection is one of the main risk factors for preterm birth. The presence of bacteria or inflammatory cytokines in amniotic fluid is significantly associated with the development of preterm labor, usually due to premature rupture of membranes.

Although there are numerous reports of a possible effect of maternal hemoglobin on neonatal weight loss and preterm birth, some researchers, such as Rasmussen, conclude that the evidence is insufficient to prove that iron deficiency may play a key role in adverse pregnancy outcomes.

Anemia and birth weight

The relationship between a pregnant woman's hemoglobin level and the baby's birth weight has been discussed repeatedly, and the possible influence of both anemia and elevated hemoglobin numbers has been assessed. Mild anemia has little effect on fetal development and size. For example, it has been noted that maternal hemoglobin concentrations of 96–115 g/L are rarely associated with low birth weight. Severe anemia, however, may increase the risk of an adverse outcome such as low birth weight or preterm birth. These complications usually develop when

maternal hemoglobin decreases <80 g/l. Researchers believe that not only the weight of the newborn, but also the weight of the placenta is a characteristic of intrauterine nutrition. Low hemoglobin concentrations during pregnancy have been shown to be associated with larger placental sizes, and this discrepancy may lead to long-term consequences, particularly an increased incidence of hypertension in adulthood. A meta-analysis of 48 randomized trials (17,793 women) and 44 cohort studies (1,851,682 women) was conducted to evaluate the effect of maternal anemia on fetal weight. The use of iron in a dose of more than 66 mg/day increases the average maternal hemoglobin concentration by 4.59 g/l compared with control and significantly reduces the risk of low birth weight. In addition, for every 1 g/L increase in mean hemoglobin level, birth weight increases by 14.0 g. In early pregnancy, both IDA and anemia due to other causes are associated with an increased risk of insufficient fetal weight gain. It has been shown that IDA in the early stages more than doubles the risk of preterm birth and low birth weight of newborns, while anemia due to other reasons is associated with a slight increase in risk, which is not statistically significant. In addition, insufficient physiological expansion of plasma volume during pregnancy can lead to limited fetal growth and a resulting decrease in birth weight. The importance of adequate plasma volume expansion for normal fetal growth has been supported by a number of studies that have shown an increased incidence of low birth weight in association with high maternal hemoglobin concentrations or high hematocrit levels. Another mechanism by which hemoglobin concentration can affect growth is the development of preeclampsia, which complicates up to 2% of all pregnancies. The absence of plasma volume expansion physiological for pregnancy (and, accordingly, the expected slight decrease in hemoglobin concentration) is associated with a threefold increase in the risk of preeclampsia during pregnancy. An interesting fact is that anemia diagnosed in the first half of pregnancy negatively affects the physical parameters of the fetus and, first of all, weight, while in the third trimester of pregnancy there is no such connection. Thus, the results of a number of studies confirm the relationship between maternal IDA in early pregnancy and the risk of weight loss in the newborn.

Conclusion

Based on numerous studies, substantial evidence has been obtained that maternal pregnancy increases the risk of premature birth and low birth weight. Given the widespread occurrence of iron deficiency in pregnant women, it is necessary to apply a preventive strategy aimed at timely detection of iron deficiency before the development of anemia. The addition of iron as part of complex preparations for pregnant women improves the mother's iron indicators during pregnancy and in the postpartum period, even at the onset of pregnancy against the background of unchanged iron reserves. Routine administration of iron-containing drugs in women during pregnancy can be used prophylactically to improve the condition of pregnant women and the weight of newborns. Timely diagnosis and adequate therapy of the problem that has already arisen make it possible to correct changes in iron metabolism in the shortest possible time and improve pregnancy outcomes.

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